IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Ming Jia
Serial No. 10/607,860
Filed: 06/27/2003
Examiner: Kevin Michael Burd
Art Unit: 2611
For: **FAST SPACE-TIME DECODING USING SOFT DEMAPPING WITH TABLE LOOK-UP**

Mail Stop Appeal Brief – Patents
Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

An **APPEAL BRIEF** is filed herewith. The Appellants enclose a payment in the amount of $620.00 as required by 37 C.F.R. § 1.17(c) to cover the fees associated with this appeal brief and with a One-month Extension of Time request. If any additional fees are required in association with this appeal brief, the Director is hereby authorized to charge them to Deposit Account 50-1732, and consider this a petition therefor.

APPEAL BRIEF

(1) REAL PARTY IN INTEREST

The real party in interest is the assignee of record, i.e., Nortel Networks Limited of 2351 Boulevard Alfred-Nobel, St. Laurent, Quebec Canada H4S 2A9, which is wholly owned by Nortel Networks Corporation, a Canadian corporation.

(2) RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences to the best of the Appellants' knowledge.

(3) STATUS OF CLAIMS

Claims 1-36 were rejected with the rejection made final on March 20, 2007.

Claims 1-36 are pending and are the subject of this appeal.

(4) STATUS OF AMENDMENTS

All amendments have been entered to the best of the Appellants' knowledge. No amendments have been filed after the Final Office Action mailed March 20, 2007.

(5) SUMMARY OF CLAIMED SUBJECT MATTER

In the following summary, the Appellants have noted where in the Specification certain subject matter exists. The Appellants wish to point out that these citations are for demonstrative purposes only and that the Specification may include additional discussion of the various elements, citations to which are not pointed out below. Thus, the noted citations are in no way intended to limit the scope of the pending claims.

Claim 1 recites a method comprising:

a) providing a symbol vector table (Figure 7, element 94; see also paragraph 0048) comprising symbol vectors corresponding to potential combinations of transmitted symbols (Figure 7, elements S_1, S_2, S_3 … S_M; see also paragraph 0048);

b) determining first Euclidean distances (Figure 7, elements 96, $d_{00...00}$, $d_{00...01}$, $d_{00...10}$, $d_{00...11}$, and $d_{11...11}$) between a received signal (Figure 7, element r) and a plurality of the symbol vectors in light of corresponding channel responses (paragraph 0049);

c) selecting a first smallest distance from the first Euclidean distances as a hard decision (Figure 7, element 100; see also paragraph 0050);

d) determining a bit vector (Figure 7, element $\hat{\bar{b}}$) corresponding to the first smallest distance (Figure 7, element 104; see also paragraph 0051); and

e) for each bit in the bit vector:

i) selecting second Euclidean distances corresponding to a competing bit from the first Euclidean distances (paragraph 0052); and

ii) selecting a competing smallest distance from the second Euclidean distances as a soft demapping value (paragraph 0052).

Claim 16 recites a system for receiving signals comprising decoder circuitry adapted to:

a) provide a symbol vector table (Figure 7, element 94; see also paragraph 0048) comprising symbol vectors corresponding to potential combinations of transmitted symbols (Figure 7, elements S_1, S_2, S_3 … S_M; see also paragraph 0048);

b) determine first Euclidean distances (Figure 7, elements 96, $d_{00...00}$, $d_{00...01}$, $d_{00...10}$, $d_{00...11}$, and $d_{11...11}$) between a received signal (Figure 7, element r) and a plurality of the symbol vectors in light of corresponding channel responses (paragraph 0049);

c) select a first smallest distance from the first Euclidean distances as a hard decision (Figure 7, element 100; see also paragraph 0050);

d) determine a bit vector (Figure 7, element $\hat{\hat{b}}$) corresponding to the first smallest distance (Figure 7, element 104; see also paragraph 0051); and

e) for each bit in the bit vector:

i) select second Euclidean distances corresponding to a competing bit from the first Euclidean distances (paragraph 0052); and

ii) select a competing smallest distance from the second Euclidean distances as a soft demapping value (paragraph 0052).

Claim 31 recites a method comprising:

a) determining first terms (Figure 7, elements 96, $d_{00\ldots00}$, $d_{00\ldots01}$, $d_{00\ldots10}$, $d_{00\ldots11}$, and $d_{11\ldots11}$) associated with differences between a received signal (Figure 7, element r) and a plurality of symbol vectors in light of corresponding channel responses (paragraph 0049), the symbol vectors corresponding to potential combinations of transmitted symbols (Figure 7, elements S_1, S_2, S_3 … S_M; see also paragraph 0048);

b) selecting a first smallest term from the first terms as a hard decision (Figure 7, element 100; see also paragraph 0050);

c) determining bits corresponding to the first smallest term (Figure 7, element $\hat{\hat{b}}$); and

d) for each bit of the bits:

i. selecting second terms corresponding to a competing bit from the first terms (paragraph 0052); and

ii. selecting a competing smallest term from the second terms as a soft demapping value (paragraph 0052).

(6) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

A. Whether Figures 1-4, 8A, 8B, and 9 should include the designation –Prior Art--.

B. Whether claims 1-36 were properly rejected under 35 U.S.C. § 101.

C. Whether claims 1-4, 7-13, 16-19, 22-28, and 31-35 were properly rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,968,198 to *Hassan et al.* (hereinafter "*Hassan*").

D. Whether claims 5, 6, 20, 21, and 36 were properly rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hassan* in view of "Turbo-Coded Modulation for Systems with

Transmit and Receive Antenna Diversity over Block Fading Channels: System Model, Decoding Approaches, and Practical Considerations" by *Stefanov et al.*, IEEE Journal on Selected Areas in Communications, IEEE INC. New York, vol. 19, no. 5, May 2001 (pages 958-968) (hereinafter "*Stefanov*").

E. Whether claims 14, 15, 29, and 30 were properly rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hassan* in view of U.S. Patent No. 6,693,982 B1 to *Naguib et al.* (hereinafter "*Naguib*").

(7) ARGUMENT

A. Introduction

Whoever invents or discovers any new and useful process, machine, manufacture, or any new and useful improvement thereof, may obtain a patent. The Appellants submit that that the pending claims are directed to a new and useful process and machine and are therefore statutory subject matter.

For the Patent Office to prove anticipation, the Patent Office must show where each and every element of the claim is taught in the reference. Further, the elements of the reference must be arranged as claimed.[1] Anticipation is a strict standard, and the Patent Office has not satisfied its burden in the present application.

B. Summary of the References

1. U.S. Patent No. 5,968,198 to *Hassan*

Hassan discloses a decoder in a coding communication system.[2] Particularly, the decoder of *Hassan* calculates a first set of Euclidean distances between a received vector "r" and a codeword having a logical zero in an information bit location. *Hassan* also calculates a Euclidean distance between the received vector r and a codeword having a logical one in an information bit location.[3] In addition, *Hassan* discloses that a decoder calculates reliability information comprising soft information output for individual bits.[4]

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[1] MPEP § 2131.
[2] See *Hassan*, col. 2, l. 16.
[3] See *Hassan*, col. 11, ll. 5-11.
[4] See *Hassan*, col. 2, ll. 1-3.

However, while *Hassan* does disclose calculating a first set of Euclidean distances, *Hassan* does not disclose creating a second set of Euclidean distances from the first set of Euclidean distances. Furthermore, *Hassan* does not disclose the feature of selecting a competing smallest distance from the second set of Euclidean distances.

2. "Turbo-Coded Modulation for Systems with Transmit and Receive Antenna Diversity over Block Fading Channels: System Model, Decoding Approaches, and Practical Considerations" to *Stefanov*

Stefanov relates to data modulation of wireless communication systems. In particular, *Stefanov* discloses applying turbo-coded modulation as an alternative to the use of space-time codes.[5] *Stefanov* discusses using turbo-coded modulation for wireless communication systems having transmit and receive antenna diversity.[6] *Stefanov* discloses that turbo-coded modulation provides a performance improvement over space-time coding.[7] However, *Stefanov* does not disclose creating a second set of Euclidean distances from the first set of Euclidean distances. Moreover, *Stefanov* does not disclose the feature of selecting a competing smallest distance from the second set of Euclidean distances.

3. U.S. Patent No. 6,693,982 B1 to *Naguib*

Naguib relates to techniques for effective wireless communications in the presence of fading, co-channel interference, and the other degradations.[8] *Naguib* discloses employing space-time block coding in transmitters having N number of transmit antennas.[9] According to *Naguib*, signals from a first terminal unit are first decoded and the resulting decoded signals are employed to cancel their contribution to signals received at base station antennas.[10] The cancellation occurs while signals at remaining K-1 terminal units are decoded.[11] When the signals at the remaining K-1 units are decoded, the decoded signals are used to cancel the contribution to signals received at base station antennas.[12] *Naguib* discloses that this procedure

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[5] See *Stefanov*, Abstract.
[6] See *Stefanov*, page 958, col. 2, l. 42 – page 959, col. 1, l.1.
[7] See *Stefanov*, page 967, col. 2, ll. 10-12.
[8] See *Naguib*, col. 1, lines 18-20.
[9] See *Naguib*, col. 2, lines 24-26.
[10] See *Naguib*, col. 2, lines 33-36
[11] See *Naguib*, col. 2, lines 36-37.
[12] See *Naguib*, col. 2, lines 40-42.

is repeated K times.[13] Nonetheless, *Naguib* does not disclose creating a second set of Euclidean distances from the first set of Euclidean distances. In addition, *Naguib* does not disclose selecting a competing smallest distance from the second set of Euclidean distances.

C. Legal Standards

1. For Establishing Anticipation

Section 102 of the Patent Act provides the statutory basis for an anticipation rejection and states *inter alia*:

> A person shall be entitled to a patent unless
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> (e) the invention was described in - (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for the purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language. . . .

The Federal Circuit's test for anticipation has been set forth numerous times. "It is axiomatic that for prior art to anticipate under 102 it has to meet every element of the claimed invention."[14] This standard has been reinforced. "To anticipate a claim, a reference must disclose every element of the challenged claim and enable one skilled in the art to make the anticipating subject matter."[15] Further, "a finding of anticipation requires that the publication describe all of the elements of the claims, <u>arranged as in the patented device</u>."[16]

2. For Establishing Obviousness

Section 103(a) of the Patent Act provides the statutory basis for an obviousness rejection and reads as follows:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the

[13] See *Naguib*, col. 2, line 44.
[14] *Hybritech Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 1379 (Fed. Cir. 1986).
[15] *PPG Indus. Inc. v. Guardian Indus. Corp.*, 75 F.3d 1558, 1577 (Fed. Cir. 1996) (citations omitted).
[16] *C.R. Bard Inc. v. M3 Sys. Inc.*, 157 F.3d 1340, 1349 (Fed. Cir. 1998) (emphasis added and citations omitted).

> subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Courts have interpreted 35 U.S.C. § 103(a) as being a question of law based on underlying facts. As the Federal Circuit stated:

> Obviousness is ultimately a determination of law based on underlying determinations of fact. These underlying factual determinations include: (1) the scope and content of the prior art; (2) the level of ordinary skill in the art; (3) the differences between the claimed invention and the prior art; and (4) the extent of any proffered objective indicia of nonobviousness.[17]

The burden is on the Patent Office to establish a *prima facie* case of obviousness.[18] "To reach a proper conclusion under § 103, the decisionmaker must step backward in time and into the shoes worn by [a person having ordinary skill in the art] when the invention was unknown and just before it was made."[19] "One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention."[20] The Patent Office may not ignore portions of the reference which teach away from the combination.[21] "[I]n general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant."[22]

For a *prima facie* case of obviousness, the combination must teach or fairly suggest all the claim elements.[23] If the Patent Office fails to establish obviousness, then the Appellant is entitled to a patent.[24]

D. Figures 1-4, 8A, 8B, and 9 Do Not Need the Designation of "Prior Art"

The Final Office Action mailed March 20, 2007 objected to Figures 1-4, 8A, 8B, and 9 alleging that these figures should be designated by a legend such as "Prior Art." In particular, the Final Office Action mailed March 20, 2007 indicated that Figures 1-4, 8A, 8B, and 9 are

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[17] *Monarch Knitting Mach. Corp. v. Sulzer Morat GmbH*, 139 F.3d 877, 881 (Fed. Cir. 1998) (internal citations omitted).
[18] *In re Fine*, 837 F.2d 1071, 1074 (Fed. Cir. 1988).
[19] *Id.* at 1073 (quoting *Panduit Corp. v. Dennison Mfg. Co.*, 810 F.2d 1561, 1566 (Fed. Cir. 1987) (paraphrase in *Fine*'s original text)).
[20] *In re Fine* at 1075.
[21] *Baxter Int'l Inc. v. McGaw Inc.*, 149 F.3d 1321, 1328 (Fed. Cir. 1998).
[22] *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994).
[23] *In re Royka*, 490 F.2d 981 (CCPA 1974); MPEP § 2143.03.
[24] *In re Glaug*, 283 F.3d 1335, 1338 (Fed. Cir. 2002).

shown in U.S. Patent Application No. 2004/0066866 to *Tong et al.* (hereinafter "*Tong*"). The Appellants traverse the objection.

The Patent Office indicated that Figures 1-4 of the present application are the same as Figures 1-4 in *Tong*. The Appellants respectfully disagree. Figure 4 includes subject matter not shown in Figure 4 of *Tong*. Importantly, Figure 4 further defines that which is shown in Figures 1-3. Thus, Figures 1-4 do not and should not include the label "Prior Art." In particular, Figure 4 includes mapping logic 52 which systematically maps data bits into symbols depending on a chosen baseband modulation. Furthermore, Figure 4 discloses that the mapping logic 52 receives data bits output from channel encoder logic 50. The Appellants submit that this feature is not shown in Figure 4 of *Tong*. Nevertheless, the Patent Office maintains the objection by indicating that Figure 4 of *Tong* discloses a QPSK/QAM mapping element 56.[25] While *Tong* does disclose mapping logic 56, the mapping logic 56 does not receive an output from channel encoder logic. Instead, *Tong* discloses that the mapping logic 56 receives reordered bits output from a bit interleaver logic 54.

Additionally, Figure 4 of the present application discusses the logical transmission architecture of a base station 14 described in Figures 1 and 2. Thus, Figure 4 further defines that which is shown in Figures 1 and 2. Furthermore, as indicated in the Specification, the logical transmission architecture may be implemented for both uplink and downlink transmissions.[26] The logical transmission structure may also be used with a mobile terminal 16, described in Figures 1 and 3. For this additional reason, Figure 4 further defines that which is shown in Figures 1 and 3. Accordingly, as Figure 4 in the present application is not the same as Figure 4 in *Tong*, Figure 4 does not require the label "Prior Art." Additionally, as Figure 4 further differentiates what is shown in Figures 1-3 of the present application, the Appellants respectfully submit that Figures 1-3 of the present application are different from Figures 1-3 of *Tong*. Therefore, Figures 1-4 of the present application do not require the label "Prior Art."

According to the Patent Office, Figures 8A and 8B are the same as Figures 6A and 6B of *Tong* and should include the label "Prior Art."[27] The Appellants respectfully disagree. Figures 8A and 8B further describe what is shown in Figure 7, which, as admitted by the Patent Office,

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[25] See Final Office Action mailed March 20, 2007, p. 2.
[26] See Specification, paragraph **[0034]**.
[27] See Office Action mailed October 16, 2006, p. 2.

includes subject matter not disclosed in *Tong*.[28] Figures 8A and 8B illustrate constellations from the perspective of two transmit antennas. In particular, Figures 8A and 8B illustrate how the present invention, as shown in Figure 7, reduces the required maximum likelihood from an original constellation of 16 points to one of four points. The Appellants submit that as Figures 8A and 8B of the present application illustrate a concept which is not described in *Tong*, Figures 8A and 8B are different from Figures 6A and 6B in *Tong* and do not require the label "Prior Art."

The Patent Office also indicated that Figure 9 of the present application is the same as Figure 7 of *Tong* and thus requires the label "Prior Art."[29] The Appellants respectfully disagree. Figure 7 of *Tong* is not the same as Figure 9 of the present application. More specifically, Figure 9 of the present application includes a block 200 having the designation "Estimate Channel Response Matrix (H)." In addition, Figure 9 includes a block 202 having the designation "Compute Inverse of MIMO Channel Response Matrix $(H^H H)^{-1}$." The Appellants submit that neither of these blocks are shown in Figure 7 nor any other Figures of *Tong*. Accordingly, for at least this reason, Figure 9 of the present application is different from Figure 7 of *Tong* and does not require the label "Prior Art."

E. Claims 1-36 Are Patentable Under 35 U.S.C. § 101

Claims 1-36 were rejected under 35 U.S.C. § 101 for allegedly being directed to non-statutory subject matter. In maintaining the rejection, the Final Office Action mailed March 20, 2007 indicates that claims 1-36 "do not contain a tangible result."[30] The Appellants respectfully disagree.

According to 35 U.S.C. § 101, whoever invents or discovers any new and useful process, machine, manufacture, or any new and useful improvement thereof, may obtain a patent therefor. Moreover, Chapter 2106 of the MPEP explicitly states that the term process means a method. Claims 1-15 and 31-36 recite a method which, among other features, selects a competing smallest distance from the second Euclidean distances "as a soft demapping value" where the soft demapping value corresponds to a received symbol, which represents transmitted data.

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[28] See Final Office Action mailed March 20, 2007, p. 2.
[29] See Final Office Action mailed March 20, 2007, p. 3.
[30] See Final Office Action mailed March 20, 2007, p. 4.

Therefore, claims 1-15 and 31-36 are directed to a method which is statutory subject matter under 35 U.S.C. § 101 and is not subject to a judicial exception.

Regarding claims 16-30, as mentioned above, 35 U.S.C. § 101 states that whoever invents or discovers any new and useful machine or manufacture may obtain a patent therefor. Claims 16-30 are directed to a manufacture. In particular, claims 16-30 recite a system for receiving signals comprising decoder circuitry which selects a competing smallest distance from the second Euclidean distances "as a soft demapping value." As such, claims 16-30 are directed toward a system, i.e., manufacture, which is statutory subject matter under 35 U.S.C. § 101 and is not subject to a judicial exception.

Nevertheless, the Patent Office states that claims 1-36 do not contain a tangible result.[31] The Appellants respectfully disagree. According to Chapter 2106 of the MPEP, the "tangible requirement does not necessarily mean that a claim must either be tied to a particular machine or apparatus or must operate to change articles or materials to a different state or thing." Chapter 2106 goes on to state an invention produces a tangible result and that a patent may be granted for an "invention of some practical method or means of producing a beneficial result or effect." The Appellants respectfully submit that the invention recited in claims 1-15 and 31-36 produces a beneficial result. As previously mentioned, claims 1-15 and 31-36 recite a method which selects a competing smallest distance from second Euclidean distances as a soft demapping value. A soft demapping value corresponds to a received symbol, which represents transmitted data. As such, a soft demapping value is a beneficial result and thus a tangible result. Furthermore, the invention recited in claims 16-30 recites a means which produces a beneficial result. As detailed above, claims 16-30 recite a system which selects a competing smallest from second Euclidean distances as a soft demapping value. The Appellants submit that at least for this reason and the reason noted above, claims 1-36 are directed to statutory subject.

F. Claims 1-4, 7-13, 16-19, 22-28, and 31-35 Are Not Anticipated by *Hassan*

Claims 1-4, 7-13, 16-19, 22-28, and 31-35 were rejected under 35 U.S.C. § 102(b) as being anticipated by *Hassan*. The Appellants respectfully traverse the rejection.

[31] See Final Office Action mailed March 20, 2007, p. 2.

1. *Hassan* Does Not Disclose the Feature of Creating a Second Set of Euclidean Distances from a First Set of Euclidean Distances

According to Chapter 2131 of the MPEP, in order to anticipate a claim under 35 U.S.C. §102, "the reference must teach every element of the claim." The Appellants respectfully submit that *Hassan* does not disclose each and every element recited in claims 1-4, 7-13, 16-19, 22-28, and 31-35. Accordingly, *Hassan* cannot anticipate these claims.

Claim 1 recites a method comprising, among other features, "selecting second Euclidean distances corresponding to a competing bit from the first Euclidean distances" for each bit in a bit vector. Claims 16 and 31 include similar features. The Appellants respectfully submit that *Hassan* does not disclose the feature of creating a <u>second</u> set of Euclidean distances from a <u>first</u> set of Euclidean distances. The Patent Office supports the rejection by indicating that *Hassan* discloses this feature at col. 4, ll. 19-21 and col. 11, ll. 54-58.[32] The Appellants respectfully disagree. At most, *Hassan* discloses calculating a Euclidean distance between a received vector r and a codeword having a logical zero in an information bit location along with calculating a Euclidean distance between the received vector r and the codeword having a logical one in an information bit location.[33] Thus, *Hassan* only discloses creating a first set of Euclidean distances. However, *Hassan* does not disclose creating a second set of Euclidean distances from the first set of Euclidean distances.

2. *Hassan* Does Not Disclose the Feature of Selecting a Competing Smallest Distance from a Second Set of Euclidean Distances

Claim 1 also recites "selecting a competing smallest distance from the second Euclidean distances as a soft demapping value" for each bit in a bit vector. Claims 16 and 31 include similar features. The Appellants respectfully submit that *Hassan* does not disclose the feature of selecting a competing smallest distance from a second set of Euclidean distances. In maintaining the rejection, the Office Action indicates that the "reliability information comprising the soft information output is calculated for each individual symbol (bit) within the hard information output."[34] The Appellants respectfully disagree. While *Hassan* does disclose calculating reliability information comprising soft information output for individual bits, the Appellants

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[32] See Final Office Action mailed March 20, 2007, p. 3.
[33] See *Hassan*, col. 4, ll. 19-21 and col. 11, ll. 5-11 and ll. 54-58.
[34] See Final Office Action mailed March 20, 2007, p. 5.

submit that the soft information does not correspond to a competing smallest distance from a second Euclidean distance.[35]

The Patent Office also asserts that "*Hassan* discloses elements 322 and 324 that calculate the closest distances between the received vector r and a hypothetical transmitted codeword having a logical one or zero in a given information bit location (column 11, lines 1-15)."[36] The Appellants respectfully disagree. *Hassan* discloses that a first element 322 calculates a Euclidean distance between a received vector r and a codeword having a logical zero in an information bit location.[37] *Hassan* also discloses that a second element 324 calculates a Euclidean distance between the received vector r and a codeword having a logical one in an information bit location.[38] However, *Hassan* does not disclose that the distance calculated by the first and second elements 322 and 324 which is smallest is selected. Instead, *Hassan* discloses that the output from the first element 322 is subtracted from the output of the second element 324.[39]

Furthermore, as detailed above, *Hassan* does not disclose creating a second set of Euclidean distances from a first set of Euclidean distances. Thus, it follows that *Hassan* cannot disclose selecting anything from a second set of Euclidean distances where the second set of Euclidean distances were formed from a first set of Euclidean distances. Even assuming *arguendo* that somehow *Hassan* did disclose creating a second set of Euclidean distances, a point which the Appellants do not concede, *Hassan* still does not disclose selecting a competing smallest distance from a second set of Euclidean distances. Moreover, even assuming *arguendo* that *Hassan* somehow did disclose selecting a competing smallest distance from a second set of Euclidean distances, a point which the Appellants do not concede, *Hassan* still does not disclose selecting a competing smallest distance as a soft demapping value.

In addition, the Appellants respectfully submit that the disclosure of *Hassan* is not applicable to the present invention. In particular, *Hassan* relates to a forward error correction decoder which deals with error correction problems. On the other hand, the present invention relates to interference corrections which are separate from forward error correction problems. More specifically, forward error correction occurs either before or after interference corrections.

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35 See *Hassan*, col. 2, ll. 1-3.
36 See Final Office Action mailed March 20, 2007, p. 3.
37 See *Hassan*, col. 11, ll. 5-8.
38 See *Hassan*, col. 11, ll. 8-11.
39 See *Hassan*, col. 11, ll. 13-15.

Therefore, for this reason and the reasons noted above, *Hassan* does not disclose all the features recited in claims 1, 16, and 31 and the Appellants respectfully request that the rejection be withdrawn. Likewise, claims 2-4, 7-13, 17-19, 22-28 and 32-35, which depend from claims 1, 16, and 31 respectively, are patentable for at least the same reasons and the novel features recited therein.

G. Claims 5, 6, 20, 21, and 36 Are Patentable over *Hassan* in view of *Stefanov*

Claims 5, 6, 20, 21, and 36 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hassan* in view of "Turbo-Coded Modulation for Systems with Transmit and Receive Antenna Diversity over Block Fading Channels: System Model, Decoding Approaches, and Practical Considerations" by *Stefanov et al.*, IEEE Journal on Selected Areas in Communications, IEEE INC. New York, vol. 19, no. 5, May 2001 (pages 958-968) (hereinafter "*Stefanov*"). The Appellants respectfully traverse the rejection.

According to Chapter 2143.03 of the MPEP, in order to "establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art." The Appellants respectfully submit that neither *Hassan* nor *Stefanov*, either singularly or in combination, disclose or suggest all the features recited in claims 5, 6, 20, 21, and 36. As mentioned above, *Hassan* does not disclose all the features recited in claims 1, 16, and 31, the base claims from which claims 5, 6, 20, 21, and 36 variously depend. In addition, *Stefanov* does not overcome the deficiencies of *Hassan*. Therefore, claims 5, 6, 20, 21, and 36 are patentable over the cited references and the Appellants respectfully request that the rejection be withdrawn.

H. Claims 14, 15, 29, and 30 Are Patentable over *Hassan* in view of *Naguib*

Claims 14, 15, 29, and 30 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hassan* in view of U.S. Patent No. 6,693,982 B1 to *Naguib et al.* (hereinafter "*Naguib*"). The Appellants respectfully traverse the rejection. As set forth above, *Hassan* does not disclose all the features recited in claims 1 and 16, the base claims from which claims 14, 15, 29, and 30, respectively depend. Moreover, *Naguib* does not address the deficiencies of *Hassan*. Accordingly, claims 14, 15, 29, and 30 are patentable over the cited references and the Appellants respectfully request that the rejection be withdrawn.

I. Conclusion

As set forth above, none of the cited references, either alone or in combination, disclose or suggest creating a second set of Euclidean distances from a first set of Euclidean distances. Furthermore, none of the references, either alone or in combination, disclose or suggest the feature of selecting a competing smallest distance from a second set of Euclidean distances. As such, the Appellants request that the Board reverse the Examiner and instruct the Examiner to allow the claims.

Respectfully submitted,

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(8) CLAIMS APPENDIX

1. A method comprising:

a) providing a symbol vector table comprising symbol vectors corresponding to potential combinations of transmitted symbols;

b) determining first Euclidean distances between a received signal and a plurality of the symbol vectors in light of corresponding channel responses;

c) selecting a first smallest distance from the first Euclidean distances as a hard decision;

d) determining a bit vector corresponding to the first smallest distance; and

e) for each bit in the bit vector:

i) selecting second Euclidean distances corresponding to a competing bit from the first Euclidean distances; and

ii) selecting a competing smallest distance from the second Euclidean distances as a soft demapping value.

2. The method of claim 1 wherein for each bit in the bit vector, further comprising determining a difference between the hard decision and the corresponding soft demapping value.

3. The method of claim 2 wherein the difference is a log likelihood ratio.

4. The method of claim 2 further comprising decoding the differences for each bit using channel decoding to recover transmitted bits.

5. The method of claim 1 wherein the first Euclidean distances are calculated using:

$$\left\{ \sum_{i=1}^{N} \left| r_i - \sum_{j=1}^{M} h_{ij} s_j \right|^2 \right\},$$

such that r is the received signal, s_i is a symbol vector, h_{ij} is a channel response vector, N is a number of receiver antennas, and M is a number of transmitter antennas.

6. The method of claim 5 wherein the channel decoding is Turbo decoding.

7. The method of claim 1 wherein the bit vector is determined by identifying one of the symbol vectors corresponding to the hard decision and selecting the bit vector based on the one of the symbol vectors.

8. The method of claim 1 further comprising creating a Euclidean distance table comprising the first Euclidean distances and creating a plurality of reduced Euclidean distance tables comprising the second Euclidean distances, wherein the first smallest distance is selected from the Euclidean distance table and the competing smallest distances for each bit are selected from corresponding ones of the reduced Euclidean distance tables.

9. The method of claim 1 further comprising:

a) decoding the received signal, which originates from a plurality of transmit antennas, using a separate STC decoding technique to determine a plurality of initial solutions;

b) identifying a limited area about each of the initial solutions; and

c) creating a decoding space corresponding to the limited area,

wherein the first Euclidean distances are determined from within the limited area.

10. The method of claim 9 wherein the limited area corresponds to a limited set of constellation points in a constellation lattice containing constellation points corresponding to possible symbols transmitted from the plurality of transmit antennas.

11. The method of claim 9 wherein the limited area corresponds to a set of four constellation points in a constellation lattice containing constellation points corresponding to possible symbols transmitted from the plurality of transmit antennas.

12. The method of claim 9 wherein the decoding space is a limited space in a multi-dimensional constellation lattice corresponding to a limited set of constellation points.

13. The method of claim 9 wherein there is an initial solution for each of the plurality of transmit antennas.

14. The method of claim 9 wherein the separate STC decoding technique is zero-forcing.

15. The method of claim 9 wherein the separate STC decoding technique is minimum mean square error decoding.

16. A system for receiving signals comprising decoder circuitry adapted to:

a) provide a symbol vector table comprising symbol vectors corresponding to potential combinations of transmitted symbols;

b) determine first Euclidean distances between a received signal and a plurality of the symbol vectors in light of corresponding channel responses;

c) select a first smallest distance from the first Euclidean distances as a hard decision;

d) determine a bit vector corresponding to the first smallest distance; and

e) for each bit in the bit vector:

i) select second Euclidean distances corresponding to a competing bit from the first Euclidean distances; and

ii) select a competing smallest distance from the second Euclidean distances as a soft demapping value.

17. The system of claim 16 wherein for each bit in the bit vector, the decoding circuitry is further adapted to determine a difference between the hard decision and the corresponding soft demapping value.

18. The system of claim 17 wherein the difference is a log likelihood ratio.

19. The system of claim 17 wherein the decoding circuitry is further adapted to decode the differences for each bit using channel decoding to recover transmitted bits.

20. The system of claim 16 wherein the first Euclidean distances are calculated using:

$$\left\{ \sum_{i=1}^{N} \left| r_i - \sum_{j=1}^{M} h_{ij} s_j \right|^2 \right\},$$

such that r is the received signal, s_i is a symbol vector, h_{ij} is a channel response vector, N is a number of receiver antennas, and M is a number of transmitter antennas.

21. The system of claim 20 wherein the channel decoding is Turbo decoding.

22. The system of claim 16 wherein to determine the bit vector, the decoding circuitry is further adapted to identify one of the symbol vectors corresponding to the hard decision and select the bit vector based on the one of the symbol vectors.

23. The system of claim 16 wherein the decoding circuitry is further adapted to create a Euclidean distance table comprising the first Euclidean distances and create a plurality of reduced Euclidean distance tables comprising the second Euclidean distances, wherein the first smallest distance is selected from the Euclidean distance table and the competing smallest distances for each bit are selected from corresponding ones of the reduced Euclidean distance tables.

24. The system of claim 16 wherein the decoding circuitry is further adapted to:

a) decode the received signal, which originates from a plurality of transmit antennas, using a separate STC decoding technique to determine a plurality of initial solutions;

b) identify a limited area about each of the initial solutions; and

c) create a decoding space corresponding to the limited area,

wherein the first Euclidean distances are determined from within the limited area.

25. The system of claim 24 wherein the limited area corresponds to a limited set of constellation points in a constellation lattice containing constellation points corresponding to possible symbols transmitted from the plurality of transmit antennas.

26. The system of claim 24 wherein the limited area corresponds to a set of four constellation points in a constellation lattice containing constellation points corresponding to possible symbols transmitted from the plurality of transmit antennas.

27. The system of claim 24 wherein the decoding space is a limited space in a multi-dimensional constellation lattice corresponding to a limited set of constellation points.

28. The system of claim 24 wherein there is an initial solution for each of the plurality of transmit antennas.

29. The system of claim 24 wherein the separate STC decoding technique is zero-forcing.

30. The system of claim 24 wherein the separate STC decoding technique is minimum mean square error decoding.

31. A method comprising:

a) determining first terms associated with differences between a received signal and a plurality of symbol vectors in light of corresponding channel responses, the symbol vectors corresponding to potential combinations of transmitted symbols;

b) selecting a first smallest term from the first terms as a hard decision;

c) determining bits corresponding to the first smallest term; and

d) for each bit of the bits:

i. selecting second terms corresponding to a competing bit from the first terms; and

ii. selecting a competing smallest term from the second terms as a soft demapping value.

32. The method of claim 31 wherein for each bit, further comprising determining a difference between the hard decision and the corresponding soft demapping value.

33. The method of claim 32 wherein the difference is a log likelihood ratio.

34. The method of claim 32 further comprising decoding the differences for each bit using channel decoding to recover transmitted bits.

35. The method of claim 31 wherein the first and second terms are Euclidean distances.

36. The method of claim 31 wherein the first terms are calculated using:

$$\left\{ \sum_{i=1}^{N} \left| r_i - \sum_{j=1}^{M} h_{ij} s_j \right|^2 \right\}.$$

(9) EVIDENCE APPENDIX

The Appellants rely on no evidence, thus this appendix is not applicable.

(10) RELATED PROCEEDINGS APPENDIX

As there are no related proceedings, this appendix is not applicable.